The Next Revolution – feasible Sustainable Development

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I like to refer to Sustainable Development as the Next Revolution.
The word "revolution" in the context of sustainability refers to a fundamental shift in how we as a species view the world and our place in it. In that regard, the sustainability revolution has been preceded by two others, the agricultural revolution, which began about 8000 years ago and the industrial revolution that has shaped so much of our modern existence.

Like these others, the sustainability revolution will take decades, possibly centuries to reach fruition and will bring changes that we here today cannot even imagine.

I would like to start with a story, a story that began 1600 years ago, in the middle of the Pacific Ocean, but one that is particularly relevant to this day and age: it is the story of Easter Island.

Among the many mysteries associated with Easter Island is the question of why the early Polynesians would choose to settle on such a barren, inhospitable scrap of land in the first place. The simple answer is that the island wasn't barren and inhospitable when they arrived. Archeological evidence indicates that the island was once heavily forested. Upon arrival the early Polynesians immediately began clearing the land for agriculture and to supply wood for fishing boats, fuel and housing, and as a means of transporting and erecting the giant statues for which the island is now famous.

By about 1500 AD the island supported a population of about 7000 people or about 150 people/square mile. At about that time the last of the trees was felled. Without the trees, thin exposed soil of the island was susceptible to erosion; no wood for fishing boats or houses or fuel; statue making came to an end.

The Easter Islanders had destroyed the resource base that sustained them. What happened next? The archeological record tells the tale of armed conflict as rival clans competed for fewer and fewer resources, spear points were manufactured in great quantities, and statues were toppled. There is evidence of cannibalism; people resorted to living in caves for shelter and protection as their civilization collapsed.

The story of Easter Island is not unique to human history. Today there is concern among a growing number of individuals and organizations that humanity on a global scale is going down the same path that the Easter Islanders and other civilizations have followed, that we are undermining the environmental, community, and economic base that sustains us.

Sustainable development in its essence is about stepping off this path and following a new direction into the future.

1. 1. FIGURES AND TRENDS

1.1. Population

Population is as good a place as any to start a discussion of our world at the start of the 21st century. In 1998, the world reached a population milestone: on October 12th of that year it was estimated that world population hit the 6 billion mark.

The projected 2050 population of about 9 billion people represents the United Nations median scenario and assumes world-wide replacement fertility by 2050 (that's two people having two babies, on average). If we are above or below replacement fertility we are looking at a reasonable range of 7.7 - 11.2 billion within 50 years.

An estimated 97% of this growth will take place in developing countries.
(Source: 1999 United Nations Population Fund statistics at: www.unfpa.org)

Absolute numbers is one way to look at population; growth rate is another. The rate of population growth, while still positive, has been declining since the 1970s and is projected to continue declining as the world approaches replacement fertility around 2050. This declining growth rate is the result of efforts around the world to improve health care (reduced infant mortality), to provide greater access to family planning, to improve educational and employment opportunities especially for women, and to raise per capita income.

Two points to take away from this discussion of population. First, we know how to reduce population. We know what works. It is not a question of waiting for some new technology or medical break-through. Second, even if world fertility rate dropped to replacement today, population momentum would carry us near the 9 billion mark by the end of the next century.

"How will we be doing in 50 years with an additional 3 billion people in the world?"

1.2. Economy

From population let us move on to a discussion of the world's economic picture – our system for creating, distributing, and consuming wealth. It is safe to say that many countries around the world, particularly the developed world, are in good economic shape. In absolute terms, more people than ever are enjoying a higher standard of living, are living longer, and are enjoying the material fruits of a relatively affluent lifestyle.

In many ways the United States is leading the world in this regard. This country has enjoyed it's longest period of continuous prosperity in it's history. The US GDP, one measure of the country's economic strength, keeps climbing ever upward.
Measures such as GDP and GNP however are not particularly accurate indicators of wealth since they record only the sum total of expenditures without regard for whether society actually benefits from these expenditures.

Money spent to clean up oil spills, treat cancer, and build prisons all serves to increase GDP. In addition these are not particularly good measures of human happiness and satisfaction.

In the US, studies indicate that the percentage of people considering themselves "happy" peaked in 1957 even though per capita consumption has doubled since that time. Still there is no denying that many of us currently enjoy the benefits of a healthy and robust economy.
(Sources: Bureau of Economic Analysis, U.S. Department of Commerce at: www.bea.doc.gov. Durning, Alan, 1992, How Much is Too Much?, W. W. Norton & Co., New York, p. 200, in reference to the National Opinion Research Center's "The Happiness Survey", www.norc.uchicago.edu)

1.3. Waste

Our affluence allows us to be a very wasteful society. Our lifestyle has been described as a system of **take, make, waste**.

- every week more than 500.000 trees are used to produce the two-thirds of newspapers that are never recycled;
- American consumers and industry throw away enough aluminum to rebuild it's entire commercial airfleet *every three months;*
- Americans go through 2.5 million plastic bottles every hour, only a small percentage of which are now recycled;
- Every day the US generates about 200 million tons of trash. Less than 25% is recycled.

These are a few of the numbers from the consumer side of the equation. It is estimated that 1% of the materials mobilized to serve US citizens are actually made into products and are in service 6 months after sale.
(Source: Environmental Defense at: www.edf.org/clickable_gcan/index.html)

1.4. World Energy Supply

Underlying our economic good fortune is the fact that the industrial economies of the world are based on the consumption of fossil fuels – a non-renewable resource.

The majority of our fuel comes from oil, coal and natural gas. There are environmental issues associated with the current way that we use all of these fuels, including nuclear energy and hydro, but most concern is aimed at our dependence on nonrenewable fuels.

The good news is that companies have started to invest in balancing the supply of nonrenewable and renewable resources. Both BP-Amoco and Shell and Petrobras, as we saw here on Monday, have recently made significant investments in solar energy and Shell is now researching hydrogen as a fuel source. And automobile manufacturers – both foreign and domestic – are racing to develop and produce alternatively fueled vehicles.
(Source International Energy Agency, Economic Analysis Division: www.iea.org/ead/ecoan.html)

What other renewable options are out there?
We've mentioned hydro, solar and nuclear power. Wind energy is another. Wind power has been the world's fastest growing energy source since 1994. North Dakota, South Dakota, and Texas have enough combined wind resource to meet US electricity demand.

Another option is biomass. The biomass resource in the US, which includes everything from forest industry residual to landfill methane, could potentially supply about 15% of the total US energy demand.

Once again, these are technologies available today; things we know how to do.
(Sources: American Wind Energy Association at www.awea.org and World Resources Institute at www.wri.org)

2. Natural Capitalism

The concern for the environment at the beginning of the 21st century is that we are beginning to test the limits of the natural systems that make life on this planet possible.
That through use and abuse we are degrading the very systems that sustain our society.
Systems that, unlike petroleum, have no substitutes.

Natural capital refers to the earth's natural resources and the ecological systems that provide vital life-support services to society and all living things. These services are of immense economic value; some are literally priceless, since they have no known substitutes. Yet current business practices typically fail to take into account the value of these assets—which is rising with their scarcity. As a result, natural capital is being degraded and liquidated by the very wasteful use of resources such as energy, materials, water,fiber,andtopsoil. (as deifned by Amory and Hunter Lovins)

Amory and Hunter Lovins, and Paul Hawken wrote the book "Natural Capitalism", describing the concept that our society needs to take into account the recognition and valuation of a part of the capital which the business world has treated as a free good – our natural resources. Well, guess what: it ain't free! And what is worst, the way we treat our natural resources, creating so much pollution and modifying the eco-systems to the extreme, create other conditions that are not "free" either – like the 'El Nino' for instance, which brings so much damage, destruction and even death.

We must therefore strive to modify the relationship between the human systems and the natural systems – which leads us to "green book-keeping - natural capitalism and our current form of capitalism should not exclude each other, they complement each other.

While industrialism has never been more successful than it is today by its own measure, we also know at the same time that every living system on earth is in decline, and that the rate of decline is accelerating, and that statement is a fact.

3. Trends are not destiny

Those are some of the important trends indicating that society is not heading in the right direction; that we are, perhaps, on the road to Easter Island. That we are beginning to bump up against the limits of our finite physical world.

As gloomy as this may sound at first, it is important to understand several things: The limits we are talking about are physical limits and not limits on human intellect, creativity, or compassion. And second, trends are not destiny – there are plenty of examples of society successfully addressing significant social, economic, and environmental problems.

The removal of lead from gasoline, international cooperation to ban the production of CFCs, and even the removal of the bald eagle from the endangered species list are all examples of these efforts.

And it is important to remember that it wasn't too long ago when women in the US did not have the right to vote, when segregation was both legal and accepted, and when industry was free to pollute the environment at will. The point being that when we make up our minds to act, we have the ability to reverse these trends, to make the world a better place, to change course.

The question becomes, how do we move forward to address these trends, to confront the idea of limits, to deal with the very real problems of today without burdening future generations?

I believe the concept of Sustainable Development provides an answer to that question. Every time you recycle a can, opt for public transportation or car-pooling, or vote for that matter, you are, in effect, practicing sustainability.

4. Sustainable Chattanooga/ Sustainable Curitiba

The phenomenon of urban sprawl has become an important issue this past decade and how many communities are incorporating the principles of sustainability as they address the issue.

In many ways the community level represents the front lines of the sustainability revolution; the place where individuals, governments, and businesses get down to the details of establishing the balance of economy, environment, and community. In fact many people consider the sustainability revolution as much a social movement as an environmental movement, and rightly so.

Chattanooga, TN is one of those cities on the front lines and has gained national and international recognition for its transformation from one of the dirtiest cities in the US to a model community working towards sustainability.

Only thirty years ago the air quality in the city was so bad that drivers often had to switch their headlights on in the middle of the day to see through the smog. Tuberculosis cases in the city were three times the national average. In fact, in 1969, the Federal government declared Chattanooga the most polluted city in the United States, quite a distinction considering the condition of many other industrial cities in the US at the time.

These conditions used to be called the "look and smell of money". By the mid-1970s, there were other problems as well. Industries had begun to change; many industrial jobs were becoming obsolete and were being phased out. In what was becoming a familiar pattern in America's industrial cities, unemployment grew, bringing crime, social unrest and racial tensions, and, ultimately, flight to the suburbs and abandonment of the downtown area.
(Source: University of Maryland, Department of Commerce, www.bmpcoe.org/bestpractices/external.chatt)

Chattanooga today is considered by many to be one of the most attractive metropolitan settings in the country. How was Chattanooga able to make this transition?

Well it took its first step in the right direction when the city's political leaders cracked down on air pollution in response to the requirements of the 1970 federal Clean Air Act, a move that in addition to cleaning the air, pumped about $40 million into the local economy (money spent on pollution prevention does wind up somewhere).

By 1988, Chattanooga had achieved attainment in terms of EPA air quality requirements.
But the really exciting work began in 1984 with the Vision 2000 project. Vision 2000 was the brain-child of several local civic and business leaders and brought together over a period of 20 weeks or so some 1700 members of the community from all walks of life to discuss their vision for the future of their city. These meetings resulted in 34 concrete goals, which in turn generated 223 city projects.

They saved the condemned Walnut Street Bridge from demolition and converted it into the country's longest pedestrian bridge. The bridge provides easy access to downtown businesses, shops, restaurants and museums and was just one of the many projects aimed at revitalizing the riverfront downtown area. A system of "greenways" was established throughout Chattanooga metropolitan area. The network provides protected trails for walkers, joggers, and bikers.

The Orange Grove Recycling center was established which is a non-profit, sheltered workshop for people with mental disabilities. In partnership with the city of Chattanooga, the Orange Grove Recycling Center trains and employs approximately 100 people to process recyclable materials collected from the community. The center has created jobs for hard to employ individuals, reduced landfill loads, and increased awareness with regard to community recycling efforts.

And the city facilitated the startup of AVS Advanced Vehicle Systems. AVS is a small, local manufacturer of electric buses. The company turns out about 30 of these vehicles a year, building each from scratch. The non-polluting buses are used to provide free shuttle service about downtown Chattanooga, attracting people to the city center and helping to relieve traffic congestion, and pollution. The buses have also been sold to a number of other cities around the country.

Chattanooga has continued this progress through the Re-vision 2000 planning project in 1993 and most recently with the Millenium III planning project focused on the city's development in the 21st century.

Chattanooga is only one example of sustainable development in practice at the community level.

Similar efforts are being made in cities all around the world. In Brazil, the city of Curitiba did not wait until it reached unreasonable levels of degradation.

Curitiba' s metro-area population grew from about 300,000 in 1950 to 2.1 million in 1990, when 42 percent of the population was under the age of 18. Another million residents are expected by 2020.

Though starting with the dismal economic profile typical of its region, in nearly three decades the city has achieved measurably better levels of education, health, human welfare, public safety, democratic participation, political integrity, environmental protection, and community spirit than its neighbors, and some would say than most cities in the United States. It has done so not by instituting a few economic megaprojects but by implementing hundreds of *mult*ipurpose, cheap, fast, simple, homegrown, people-centered initiatives harnessing market mechanisms, common sense, and local skills. It has flourished by treating all its citizens —most of all its children —not as its burden but as its most precious resource, creators of its future. It has succeeded not by central planning but by combining farsighted and pragmatic leadership with an integrated design process, strong public and business participation, and a widely shared public vision that transcends partisanship.

The city is blessed with twenty downtown blocks of pedestrian streets that have regenerated its public realm and reenergized its commerce and its polity. Of the many initiatives that changed the city's direction, the historic boulevard's bold resurrection, just before it was to have been destroyed for an overpass, was the most emblematic. At that time nearly every city in the world was demolishing its historic core so bigger roads could handle the onslaught of cars carrying people between districts zoned for disparate activities.

Curitiba started it's journey to rehabilitation in the early 70's, under the government of mayor Jayme Lerner, a thirty-three-year-old architect, engineer, urban planner, and humanist.

And while each of these initiatives is unique in its own right, their common bond is that they are driven not by some top-down government imposition or by the demands of marginalized protest organizations but by people being given the chance to ask the simple question, "what do we want our community to be?"

5. The business solution: Interface

The business community is also beginning to understand the significance of sustainable development, in this case as it pertains to the marketplace.
Competitive advantages associated with a sustainable approach to the market include reduced operating expenses, incentives for innovation, improved customer and employee relations, and the development of new market opportunities.
Interface Corporation is the largest commercial carpet manufacturer in the world and is headquartered in Atlanta Georgia.
Back in 1994 Ray Anderson had a bona fide epiphany after contemplating his company's environmental performance (or lack thereof) and after reading a book entitled The Ecology of Commerce, written by businessman Paul Hawken.
Since that time, he has declared his intention to make Interface the world's first sustainable corporation.
(Source: Interface Inc. at www.interfaceinc.com)

5.1. Interface Products

That a flooring manufacturer is leading the exploration into the world of sustainable business development may seem odd until you consider that it takes about two pounds of fossil fuel to create one pound of nylon carpet, that the typical nylon carpet contains over 1000 chemicals, spends about seven years in service , and will last for 20,000 years or more in a landfill.

There are over 5 billion pounds of carpet in landfills today with the Interface name on it. The company finds figures such as these not just bad for the environment but as signs of bad business as well and has developed a seven-point path to sustainability to guide its strategic development.

These steps include a company-wide effort to eliminate waste (which to date has saved the company and its share-holders some $70 million), the incorporation of renewable energy sources into its production processes, education of employees, customers, and suppliers about the environmental impact of their business, and the re-designing the business itself towards more of a service industry.

The company realizes that most customers do not want the carpet itself but rather the service that the carpet provides--aesthetics, ergonomics, comfort--a very simple idea with potentially profound business implications.

Accordingly, Interface has created its Evergreen Lease option whereby Interface is responsible for maintaining its customer's carpeting, replacing only what becomes worn.
The Evergreen Lease saves money, saves resources, and represents a new market opportunity for Interface.

Another example of sustainability-driven innovation at Interface is the company's Solenium floor-tile product. Solenium is designed to be completely recyclable, the production process is less complex and less wasteful, and the product outperforms standard floor-tile products to the extent that the company does not feel the need to market it as a "green" product.

6. The Design Example – The Adam Joseph Lewis Center for Environmental Studies

The owners began this project by asking:

- Is it possible--even in Ohio--to power buildings by current sunlight?

- Is it possible to create buildings that purify their own wastewater?
- Is it possible to build without compromising human and environmental heath somewhere else or at some later time?

The Roof
The roof's first solar cells will be replaced within a few years when new solar cells offering more electrical generating power become available. The plan is for the building to generate more electrical power than it needs and, in fact, to become a supplier

The Landscape
North side of the building is protected by an earthen berm and tree grove. No pesticides will be used for the gardens, orchards, and restored forest on the east side of the building.

The Interior
The interior is designed to change and adapt over time. Carpeting is leased from the manufacturer, Interface, who recycles worn-out carpeting for reuse. The wood used to make the desks and chairs comes from sustainably managed forests. Seating material used for the chairs in the auditorium is biodegradable.

Solar Design
The design includes overhanging eaves and shading trusses that shade the summer sun while allowing winter heat gain.

Lighting
To take advantage of daylight and heat gain, major public rooms such as classrooms will face south and west. The glass panes are specially treated to vary the amount of UV light that can both enter and leave the building, helping to maintain an even temperature inside.

The Pond
The key function of the pond is water storage for irrigation. Water slowly seeps into the ground, purified by the plants, microorganisms, and soil. The plan is to someday use a portion of this water for recycling.

6.1. Monthly energy consumption

The graph depicts average daily electricity use and solar production in the AJLC by month since the installation of the data monitoring system (scale on left hand axis) was completed. Components of consumption are broken down by HVAC (heating, ventilation and air conditioning), lights (including exterior and parking lot lights) and equipment (computers, printers, copiers, microwave oven, wastewater treatment system, etc.).

The red line represents the percent of the building's energy load that is met through production by photovoltaic cells on the roof of the building (production/consumption, see scale on right hand axis). The bold red reference line signifies 100% of total building needs met by solar power.

How has the building performed so far?
•In 5 out of the past 7 months, energy production by the solar cells has exceeded 70% of energy consumption.
•During the months of June and July the building was a net-energy exporter.
•Over the past 7 months, the building has consumed a total of 21,500 Btu/sq.ft, well under the consumption of a conventional building of its size.

6.2. Solar Design

- **3,700 square foot of photovoltaic (PV) panels** on the main south-facing curved roof provide electrical energy for the building.
- **Building Orientation** is elongated along the east-west axis to optimize passive solar performance.
- **Daylighting** is provided for all interior spaces, reducing lighting loads.

  Direct solar gain is collected through south-facing glass in the Atrium and classrooms workspaces. The glass panes are specially treated to vary the amount of infra red light that can both enter and leave the building, helping to maintain an even temperature inside.
- **Thermal Mass** in concrete floors and exposed interior masonry walls retains and re-radiates heat to temper the space.

6.3. Energy Efficiency

- **R-30 to R-40 roof assemblies.**
- **Energy efficient wall design** was employed, including **R-21** masonry cavity-walls and featuring pressure-equalized rain-screen assemblies with air barrier construction.
- **Integrated building controls** included advanced, central building controls for mechanical, security, fire, and Living Machine systems.
- **Electrical lighting** uses only 0.9 watts per square foot of building space.

  Hall and stairwell lights are connected to sensors for both movement and daylight while classroom and office lights are motion-sensored.

6.4. Material Selection

- **Durable, low-maintenance materials** are used throughout, including brick exterior walls, interior walls composed of stained concrete masonry units, and steel structure.
- **Recycled products** include the steel framing, aluminum for the roof, windows and curtainwall frames, ceramic tiles in the restrooms, and toilet partitions.
- **All wood** are Certified Forest Products, supplied from certified sustainably-managed forests, as determined by standards and specification language endorsed by the Forest Stewardship Council (FSC). The certified status of the forest of origin is verified, as well as the chain of custody from the forest through manufacturing and fabrication. This includes the wood roof decking structure, glued-laminated beams, trim, plywood and wood framing members, and veneered wood panels.

- **Products of Service™:** The raised floor and carpeting are leased to the College by Swiss manufacturer Interface. The College gains the services of the floor and carpet, without the liabilities of ownership. Interface retains ownership of the floor and carpet, allowing it to reuse or recycle the components when their service life is complete.

6.5. Wastewater treatment - LIVING MACHINE

- This engineered wastewater treatment system is modeled on natural wetland ecosystems and serves as research and teaching tool.

- The Living Machine is a resilient system due to its mechanical simplicity and biological complexity, allowing it to replicate and accelerate the natural purification processes of ponds and marshes. Diverse communities of bacteria, algae, microorganisms, plants, trees, snails, and fish interact in tanks and act as living bio-filters.

- The end-goal of the Living Machine is to recycle the treated "gray water" through the building's toilets, thus helping to conserve water.

6.6. How much did the building cost?

There are many ways to evaluate the cost of a building. At this stage, numbers can be reported on the direct costs of planning and construction. Equally important, however, is an estimate of the life-cycle costs of equipment and the long-term savings associated with incorporation of energy efficient technologies that reduce daily resource consumption. In addition to quantifying these long-term costs and savings, research is currently under way to systematically assess the full social and ecological costs and benefits associated with the choices made in building the AJLC.

6.7. Monitoring

Ed Hancock and Shanti Pless of the National Renewable Energy Lab have worked with professor John Petersen and Alex Maly '02 to develop a system to monitor the building's energy use and key environmental variables throughout the building and landscape. These numbers must be monitored to assess and promote the efficiency of green building.

(source: www.oberlin.edu/newserv/esc/)